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ABSTRACT

Two experiments aimed at extending the principles of paired-associates learning transfer to the acquisition of reading skills are reported. Approximately 15 first graders were randomly assigned to each of the 10 treatment conditions. In the first experiment, four types of letter training were compared to two control conditions. The experimental conditions were (1) high phonic correspondence between letter name and sound (ABAcBc), (2) high mediating correspondence between letter name and sound (ABAcB'c), (3) low correspondence between letter name and sound (ABAcCc), and (4) first task observation of letter stimuli (AOAcBc). The control conditions were (1) warm up (ABCcDc) and (2) no letter training (--AcBc). Results showed a significant effect attributable to presentation method, with the ABAcBc and ABAcB'c tasks producing the greatest transfer and AOAcBc producing the least. The second experiment used preliminary training in mediational cues in ABAcBc to determine whether this would increase transfer to the second task. Three groups, ABAcBc, ABAcCc, and --AcBc, were compared. Results showed that training improved performance significantly. Conclusions reached after the two experiments were that (1) the ABAcBc paradigm produced maximum transfer, indicating that a phonics approach to reading is the most efficient and (2) mediation skills training is valuable in tasks such as these. References are included. (MS)

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THE EFFECT OF LETTER TRAINING ON THE ACQUISITION OF WORD READING SKILLS

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July 30, 1970

U. S. Department of
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SUMMARY

This research was aimed at extending the principles of paired-associates (P-A) learning transfer to the acquisition of reading skills. Modification of the traditional A-B, A'-B' and A-B, A'-C paradigms were employed in which the second task stimuli and responses were compounds (words) made up from the first task stimulus and response elements (letters).

The results indicate that phenomena observed in traditional P-A transfer studies apply to some extent, to reading acquisition. However, the mediational processes of first graders appears to be poorly developed. This tends to reduce the amount of positive transfer observed in the A-B, A'-B' paradigm. Mediational skills training appear to increase the magnitude of that transfer.

The effect of warm-up seems to be much greater for first graders than it does for adults. Stimulus observation training during the first task tends to produce negative transfer to the second task for children and positive transfer for adults.

These results tend to suggest that a phonics approach to reading is most efficient.

The results indicate that more research is needed to plot the course of mediational skills development in the child.

INTRODUCTION

Repeated investigations have revealed that the ability to name letters prior to receiving reading instruction correlates with subsequent reading achievement (Gavel, 1958; Nicholson, 1958; Olson, 1958; and Weiner & Feldman, 1963). However, it is not clear if knowledge of letter names enhances reading achievement or if those students with greater reading aptitude simply learn the names of letters without benefit of formal instruction. Durrell et al (1958) and Potts & Savino (1968) report that a letter emphasis reading program produced greater reading achievement than an incidental letter instruction program. But since so many treatment factors varied between groups, one cannot be certain of the specific effects of letter training on reading achievement.

When beginning readers are given preliminary training with letters prior to actual word reading instruction they are, in essence, learning a paired-associates transfer task. However, a major difference between the traditional paired-associates transfer task and reading is that in reading, the learner is exposed to stimulus elements (letters) in the first task and compounds of those elements (words) in the second, while in paired-associates transfer paradigms the second task stimuli are replicas or variants of the first task stimuli. A critical issue then is the relationship between these two paradigms. Namely, do the principles which have been derived in traditional paired-associates transfer experiments apply to the reading task? A major objective of this research is to explore this issue.

If the second task stimulus words in the learning-to-read (LTR) task are thought of as variants of the first task letter stimuli, then the A-B, A'-C (ABA'C) and the A-B, A'-B' (ABA'B') paradigms have particular relevance to LTR. For further amplification of these paradigms, see Appendix.

The classification of the LTR task as ABA'C or ABA'B' depends upon the relationship of the letter name in the first task to the letter sound within the word in the second task. If this relationship is high, the ABA'B' paradigm is appropriate,if it is low, the ABA'C paradigm is appropriate. For example, if the letter "A" is labeled ă and the word apple is read, there is high letter label sound correcpondence (ABA'B'). If, however, it is labeled ā and apple is read, there is low letter label sound correspondence (ABA'C).

In order to more easily maintain the distinction between the traditional ABA'B' and ABA'C paradigms, and the corresponding LTR compounding paradigms, the notation ABA_cB_c and ABA_cC_c will be used to designate the latter two.

The ABA'C paradigm typically yields negative transfer to the A'C task (Kjeldergaard, 1968), with apparently two exceptions: (1) when response class differences between B and C lists are large (Postman, Keppel and Stark, 1965), and (2) following massive overlearning of the first list (Mandler, 1962). On the other hand, the ABA'B' paradigm seems to yield positive transfer (Kjeldergaard, 1968; Osgood, 1948). At issue then is whether ABA_cC_c and ABA_cB_c paradigms produce results analogous to those of the ABA'C and ABA'B'. The results of several studies

seem to indicate that they do. Muehl (1962), for example, found that a variant of the ABA_cC_c paradigm produced negative transfer when compared to a no pretraining control. He, however, pretrained his Ss on only one of the stimulus elements in each of the second task stimulus compounds. That is, his ABA_cC_c Ss knew names for only one of the letters in each of the task II words. He used kindergarten children as subjects and real letters and words as stimuli.

Bishop (1964) using adults and arabic words compared ABA_cB_c transfer to a no pretraining control. Her results conform to those of the ABA'B' paradigm.

Jeffrey and Samuels (1967) essentially replicated Bishop's experiment but with children and nonsense words. In addition, control group Ss learned an irrelevant initial paired-associates task as a control for nonspecific transfer. They report that the phonic letter training produced greater transfer to the word reading than did irrelevant associative training.

Muller (1970) using adults compared the ABA_cB_c and ABA_cC_c paradigms with a no letter training control. He found with a small amount of letter training (6 trials) transfer was positive for only the ABA_cB_c group. Following more extensive letter training (13 trials) both paradigms, ABA_cB_c and ABA_cC_c yielded positive transfer.

In these studies, the experimental group was compared with either a no pretraining control or a nonspecific transfer control (ABC_cD_c). The transfer produced by the ABA_cB_c and ABA_cC_c task I training, however,

may represent transfer effects from several sources. Another objective of this study was to evaluate some of these potential sources of transfer.

For example, it is possible that at least part of the positive effects of learning names for letters is due to experience to discriminating between or observing letters. Stimulus predifferentiation studies have repeatedly shown transfer from stimulus observation training (AOAB) to be positive when compared to a no preliminary training condition (Goss, 1953; Smith and Goss, 1958). Muller (1970) also found positive transfer to a simulated reading task following 13 trials of letter observation training (AOA_cB_c).

Nonspecific factors may also contribute to transfer in the reading task. That is, while the child is learning names for letters, he is also learning how-to-learn associations to graphic stimuli. This source of positive transfer has long been recognized in paired-associates transfer literature and was controlled for in the Jeffrey and Samuels (1967) experiment.

To summarize, it appears that preliminary letter-name training with high name-sound correspondence training (ABA_cC_c) appears to produce negative transfer. However, the specific transfer effects may depend upon the similarity between response classes or degree of original learning.

This seems to indicate that the phonic approach to reading has the greatest potential for maximizing rate of reading acquisition. The tentativeness of this conclusion, however, should be quite apparent.

Further, the transfer produced by letter labeling pretraining appears to include transfer effects resulting from simple stimulus observation experience, learning-to-learn or warm-up, and response familiarization.

EXPERIMENT I

In order to evaluate the generality of the principles of P-A transfer, and to explore the importance of the various potential sources of transfer, the following experiment was performed.

Experiment Ia

Method

Design. -- Four types of letter training were compared to two control conditions. The four types of letter training were, 1) high phonic correspondence between first task letter name and second task letter sound (ABA_cB_c); 2) high mediated correspondence between letter name and letter sound ($ABA_cB'_c$) (med); 3) low correspondence between letter name and letter sound (ABA_cC_c) and; 4) first task observation of letter stimuli (AOA_cB_c). The two control conditions were: 1) warm-up (ABC_cD_c) and 2) no letter training ($--A_cB_c$).

In the $ABA_cB'_c$ (med) paradigm the first task letter names did not resemble second task letter sounds but first task names were names of letters that had the second task sound. For example, stimulus letter 1 may have been labeled "see" and in the second task had the sound "cu" as in cut. Thus, since the Ss employed in this experiment had already received some in-school training in letter names and letter sound, there

was high mediated correspondence between first task responses (B) and second task responses (B'_c).

Norcross and Spiker (1957) pointed out that Ss receiving observation training may not learn as much about the stimuli as the labeling S because the former are not required to make discriminations between the stimuli. That is, if an AOA_cB_c S is not discriminating between stimulus 1 and 2, he is not typically given feedback about this failure while the ABA_cB_c, or ABA_cC_c S is. To control for this, Norcross and Spiker (1957) employed a simultaneous presentation procedure in which two stimuli were presented to the S at the same time. The labeling S had to label each, the observing S had to say whether they were the same or different.

This procedure, as well as the traditional successive stimulus presentation method is employed in this experiment. Specifically half the Ss under each experimental treatment condition received simultaneous stimulus presentation training. Half received successive stimulus presentation training.

Thus, this represents a 4 x 2 factorial design with four levels or types of training; ABA_cB_c, $ABA_cB'_c$ (med); ABA_cC_c and AOA_cB_c; and two presentation modes; simultaneous and successive. Two control groups, warm-up and no-letter-training, are compared with each of the experimental groups.

Stimuli and responses. -- Vanderplas and Garvin (1959) six-point random shapes were used to nonsense letters and nonsense monosyllabic words were used as responses for the letters. Each training group saw four nonsense letters and four words each made up from two nonsense letters. The second task words were familiar words.

Complete lists of stimuli and responses for each of the tasks are found in Table 1.

Subjects. -- Approximately fifteen first grade Ss from Las Cruces Public Schools were randomly assigned to each of the ten treatment conditions. Exact numbers can be found in Table 3. These Ss did not have a known language or learning problem. They also had received some reading instruction, since Ss were tested during December and January of the first grade year.

Procedure. -- Stimuli in tasks I and II were presented individually by a slide projector in a 4:2.5-sec paired-associates procedure. That is, the stimulus appeared for 4 seconds then the label was presented and the stimulus remained visible for another 2.5 seconds. There was a one-second inter-trial interval. Labels were presented aurally by a tape recorder.

Task I training continued for 20 trial blocks. A trial block consists of one and only one presentation of each of the four stimuli. Task II training continued until the S reached a criterion of two successive errorless trial blocks or to a maximum of 20 trial blocks.

Results

Letter training. -- The mean number of correct label anticipations on the final eight stimulus presentations (four presentations of two stimuli for the simultaneous group) for each of the task I learning groups is presented in Table 2. An analysis of variance applied to the six experimental groups revealed a significant effect attributable to presentation mode

TABLE 1

Stimulus and Response Terms
Employed in the Experimental Tasks

Task	Group	Vanderplas & Garvin (1959) Stimuli	Responses	
I	ABA_cB_c	5	CA	as in cat
		17	BO	as in boat
		23	NU	as in nut
		29	TU	as in tub
	ABA_cB_c'(med)	5	SEA	
		17	BEE	
		23	IN	
		29	TEA	
	ABA_cC_c	5	LA	as in Lollipop
		17	PI	as in pig
		23	BA	as in bay
		29	GOO	as in goof
	ABC_cD_c	8	LA	as in Lollipop
		15	PI	as in pig
		21	BA	as in bay
		27	GOO	as in goof
II	All	5, 23	CAN	
		5, 29	CAT	
		17, 23	BONE	
		17, 29	BOAT	

TABLE 2

Mean Number of Correct
Label Anticipations on the Final
Eight Stimulus Presentations of the
Letter Naming Task

	Presentation Mode	
Paradigm	Successive	Simultaneous
ABA_cB_c	7.00	7.47
ABA_cB_c(med)	7.53	7.87
ABA_cC_c	6.93	7.50
ABC_cD_c	7.20	

($F = 4.57$, $df = 1, 80$, $p < .05$). The actual differences between the means were so slight, however, that they probably did not have a differential effect on task II performance. The significant F is due to the fact that most Ss in each of the groups were at asymptote and thus within group variance was very low.

Word training. -- The data of principle concern in this study is performance on the word reading task. The mean number of trials to criterion for each of the treatment groups is presented in Table 3.

Inspection of the table indicates that of the experimental groups, the ABA_cB_c and ABA_cB_c (med) paradigms produced the greatest transfer to the word reading task, and the AOA_cB_c the least. Simultaneous presentation of task I stimuli seems to facilitate acquisition of the word reading task in all conditions except the AOA_cB_c.

When transfer of the experimental groups is compared with the no letter training control (---A_cB_c) we see that all the letter labeling groups seem to reflect positive transfer while the AOA_cB_c groups reflect negative.

When these groups are compared with the warm-up control (ABC_cD_c), only the ABA_cB_c and ABA_cB_c (med) paradigms receiving simultaneous letter presentation training display positive transfer.

An analysis of variance applied to the 4 x 2 experimental conditions revealed a significant paradigm effect but an insignificant presentation mode effect and an insignificant interaction. A summary of this analysis is presented in Table 4.

TABLE 3

Mean Number of Trials to Criterion on the Word Reading Task

Paradigm		Presentation Mode: Successive	Presentation Mode: Simultaneous
ABA_cB_c	M	45.13[1,2]	39.73[1]
	N	15	15
ABA_cB_c (mediated)	M	47.00[1,2]	30.73[1,2]
	N	15	15
ABA_cC_c	M	57.78[2]	54.85[2]
	N	14	12
AOA_cB_c	M	64.13[1,2]	66.87[1,2]
	N	15	15
ABC_cD_c (control)	M	40.40	
	N	15	
$--A_cB_c$ (control)	M	58.07	
	N	15	

1. Significantly different from $--A_cB_c$ control ($p < .05$)
2. Significantly different from ABC_cD_c control ($p < .05$)

TABLE 4

Analysis of Variance Summary Table
For Task II, Experiment Ia

Source	cf	SS	MS	F
Training Type (T)	3	918.02	306.01	9.01*
Presentation Mode (P)	1	59.74	59.74	1.76
T x P	3	95.24	31.75	0.93
Error	109	3701.83	33.96	

*p < .05

A Dunnetts test was then applied to the differences between the control groups and the experimental groups. The results of this analysis are summarized in Table 3. When the --A_cB_c group is used as the control, all the ABA_cB_c and ABA_cB_c (med) groups reflect significant positive transfer; the AOA_cB_c groups, negative transfer and the ABA_cC_c groups, zero transfer.

When the ABC_cD_c group provides as the control baseline, only the ABA_cB_c (med) simultaneous group exhibits positive transfer, the simultaneous presentation ABA_cB_c group reflects zero transfer and all the remaining groups reflect negative transfer.

Discussion

When transfer of the experimental groups is evaluated in relation to the --A_cB_c control, the results of ABA_cB_c and ABA_cB_c (med) groups are in general agreement with the results of Bishop (1964), Muehl (1962) and Muller (1970). A notable difference between the results of this experiment and those of Muller (1970) is with regard to the AOA_cB_c condition. Muller (1970) observed positive transfer using adult Ss. Here negative transfer was found with child Ss.

This difference may reflect a difference between these groups with regard to their ability to covertly label stimuli or to use their covert labels in subsequent tasks.

Another difference between these results and those of Muller (1970) is found in the ABA_cC_c groups' performance. Muller found positive transfer

while the results of this experiment reveal neutral transfer. These results again tend to indicate that the beginning readers may not be able to use mediators as effectively as adults. It is also possible that the child Ss were not able to differentiate between the response classes of the two tasks. That is, the children could not differentiate between the responses on the basis of familiarity or number of syllables. Transfer in the ABAC paradigm seems to be positive when the two response lists are well differentiated (Postman, Kepple and Stark, 1965).

Level of original learning is also another possible account for the discrepancy between the results of Muller (1970) and those of the present study with regard to the ABA_cC_c group is in terms of level of task I learning (Mandler, 1962). However, Muller (1970) observed 10.8 out of a possible 12.0 correct anticipations on the final 2 trial blocks of task I ABA_cC_c training. This is approximately the same level of performance as observed in the ABA_cC_c group in the present experiment.

The performance of the ABC_cD_c group seems to be extremely high and interpretation of the data using this as the transfer baseline is difficult. In fact, when these data are compared with those of Jeffrey and Samuels (1967) and Muller (1970) it would appear that the performance of the ABC_cD_c is unreliably high and that an experimental replication of this finding would be necessary before it would be safe to draw implications from this particular group's performance.

Experiment Ib

This experiment was a replication of the two control conditions of Experiment Ia. Its purpose was to evaluate the reliability of the ABC_cD_c group's performance.

Method

All procedures, stimuli, subjects were identical to those employed in Experiment Ia.

Results

Task I. The mean number of task I correct label anticipations on the final two trial blocks of training for the ABC_cD_c group was 7.9.

Task II. The mean number of trials to criterion for the ABC_cD_c and $--A_cB_c$ groups were respectively 40.6 and 63.8. These values are almost identical to those of the Experiment Ia groups.

Discussion

The performance level of the ABC_cD_c group observed in Experiment Ia appears to be reliable. This suggests that with young children the warm-up factor has much more relative importance than with adults. Also, the positive transfer of the ABA_cB_c and $ABA_cB'_c$ (med) groups over the $--A_cB_c$ control in Experiment Ia is probably due in large measure to warm-up factors.

It is interesting to note that the simultaneous presentation, $ABA_cB'_c$ (med), group displayed greater positive transfer than the ABA_cB_c groups. This appears to be contrary to what would be expected. Specifically we

would expect the greater physical similarity between first and second task responses of the ABA_cB_c groups to yield greater transfer. However, it would appear that with children of this age the relationship between first and second task letter names and sounds must approach identity or that some sort of training in specific mediational skills must be provided before positive transfer will occur.

This suggests that mediational skills in children are far inferior to those of adults and that the use of adults in a simulated reading task is of questionable value.

EXPERIMENT II

The results of the first experiment were not precisely as expected and consequently a different direction than initially planned was taken in Phase II. Inspection of the acquisition phenomena for the ABA_cB_c and ABA_cB_c (med) groups indicates that first task labels were operating as mediators but they were not being used with great efficiency since it still took a great many trials for Ss in these groups to reach criteria. Muller (1970) in a similar experimental task found that adults took very few trials to reach second task mastery with the ABA_cB_c paradigm. Also, the superior performance of the ABA_cB_c (med) group indicates that transfer is greatest when specific mediational training is provided. Thus, in Phase II, Ss were given preliminary training in the use of the mediational cues provided in ABA_cB_c training in order to determine if this would increase transfer to the second task for the ABA_cB_c group. Three groups of Ss were compared - ABA_cB_c, ABA_cC_c and --A_cB_c.

Method

Design. -- Subjects were trained under three conditions, ABA_cB_c, ABA_cC_c and $--A_cB_c$.

Procedure. -- Stimuli, responses, and time sequences were identical with those of the first experiment. The only difference was that Ss were not receiving mediational training prior to being given the first learning task. The E would say to S "If I say Pi-gu, you say?" When S could not respond E then supplied the correct response, in this case, pig.

Each S was given 25 practice words. None of the task I sounds or task II words appeared in the mediational training list. All Ss mastered the mediation training task.

Results

Task I. -- The mean number of correct label anticipations on the final two trial blocks of task I training for the ABA_cB_c and ABA_cC_c was 7.8 and 7.6 respectively.

Task II. -- The mean number of trials to criterion for the ABA_cB_c, ABA_cC_c and $--A_cB_c$ groups respectively are 30.87, 49.80 and 67.67. An analysis of variance revealed a significant difference among these means ($F = 7.73$, $df = 2, 28$, $p < .05$). Dunnett's test indicated that both the ABA_cB_c and ABA_cC_c groups were significantly different from the $--A_cB_c$ control.

Discussion

The mediational training appears to have improved task II performance of the ABA_cB_c group (45.13 Experiment I, 30.87 Experiment II). However, rate of task II learning still does not approach that of adults (Muller, 1970). This again suggests that differences between adults and children were greater than originally suspected.

The positive transfer of the ABA_cC_c group observed in this experiment appears to be somewhat contradictory to the results of Experiment I. However, inspection of the data suggests that the mediational training may have suppressed performance of the $--A_cB_c$ group rather than raising performance of the ABA_cC_c group. It is interesting to note that the positive transfer exhibited by the ABA_cC_c group is consistent with the findings of Muller (1970).

CONCLUSIONS

The results of this project are consistent with earlier findings (Bishop, 1964; Jeffrey and Samuels, 1967; and Muller, 1970) in that the ABA_cB_c paradigm seems to produce maximum transfer. This suggests that a phonic approach to reading instruction is most efficient.

The use of mediation skills training seems to be mandatory in this type of task. This is consistent with the techniques employed by Jeffrey and Samuels (1967). This confirms what has long been implied by instructional practice; that children must be taught the mediational skills involved in phonic approaches to reading. It also indicates that the use of adults in a simulated reading task is of questionable utility.

Future research needs to be directed at establishing the relationship between letter name and letter sound similarity and transfer. That is, how similar must the letter name be to the letter sound? Another issue is that of the number of sounds which can efficiently be associated with a single letter. In other words, is reading acquisition faster if each letter has a unique sound or if one letter has a family of related sounds associated with it.

Also, the exact nature of the differences between adults and children with regard to mediational skills must be more thoroughly examined. An area of especial importance is that of spontaneity of mediation in children.

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APPENDIX

A DESCRIPTION OF THE PAIRED-ASSOCIATES LEARNING AND TRANSFER TASKS

Paired-associates learning. -- In the paired-associates learning task, the subject is asked to learn a specific response to each of a set of stimuli. For example, the learner may be required to learn a specific girl's name to each of a set of pictures of girls. Generally, the stimulus term is referred to as S or S_k where $_k$ is an integer identifying the specific stimulus. For example, if one were using three stimuli, he would refer to them as S_1, S_2 and S_3. Similarly, the response terms are designated R or R_k such that R_k is paired with S_k. That is, R_1 is learned to S_1, R_2 to S_2 and so on.

In the paired-associates learning experiment, stimulus and response presentations are rigidly controlled. The stimulus term is presented first alone and then with the response term. A typical presentation sequence might be: S_1 for two seconds, $S_1 + R_1$ for two seconds, S_2 for two seconds, $S_2 + R_2$ for two seconds and so on.

Generally, the stimuli are presented in trial blocks. A trial block is one presentation of each of the stimulus terms. The order of the stimuli within the trial blocks is almost always varied from block to block so the subject cannot learn the responses through serial order.

The stimulus and response terms are usually presented visually. That is, the stimulus may be a printed word or a picture; the response, a printed word. However, S and R terms could be presented in any of a number of modes. The response the subject makes is usually a verbal

utterance but is not necessarily restricted to that domain. For example, the subject may learn a particular manipulatory response to a stimulus.

The subject is instructed to anticipate the response term by making the response prior to the presentation of the response term. Performance is evaluated in terms of the number of correct response anticipations per trial block.

Transfer of paired-associates learning. -- Transfer of paired-associates learning is studied by having the subject learn an initial paired-associates list and a subsequent paired-associates list. Transfer is defined as the effect of learning the initial list upon the learning of the subsequent list.

The nature of the two lists is usually described with two pairs of letters, e.g., A-B, C-D. This description is referred to as a transfer paradigm. The first letter in each of the pairs, A and C, symbolizes the set of stimulus terms in each list. The second letter in each of the pairs, B and D, symbolizes the set of response terms in each list.

When two letters in the paradigm are identical, the corresponding stimulus or response terms are identical. For example, in the A-B, A-C transfer paradigm the stimulus terms in the initial list are identical to those in the subsequent list. In the paradigm A-B, C-B, the response terms are identical. In the A-B, C-D paradigm, neither the stimulus nor response terms are identical.

On occasion the stimulus or response terms of the second task will be similar to, but not identical with, the corresponding terms of the first

task. In this case the mathematical prime-symbol is used to designate similarity. For example, in the A-B, A'-C paradigm, the first and second task stimulus terms are similar.

Further, in the A-B, A'-B' paradigm, both the first and second task stimulus and response terms are similar.